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EXAMINER	
MATTHEWS, COLLEEN ANN	

ART UNIT	PAPER NUMBER
2811	

NOTIFICATION DATE	DELIVERY MODE
06/10/2009	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No.	Applicant(s)	
	10/797,876	DIP ET AL.	
	Examiner	Art Unit	
	Colleen A. Matthews	2811	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *02 March 2009*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-8,10,11,13-21 and 26-28* is/are pending in the application.

4a) Of the above claim(s) *21* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-8,10-11,13-20,26-28* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Drawings

The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the "unreacted portion" (Claim 1 line 5) and the "surface portion (Claim 1 line 6) must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Objections

Claim 1 is objected to because of the following informalities: The term "an unreacted portion" (line 5) is objected to for not reciting the manner in which the surface layer is considered unreacted. Appropriate correction is required.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-3, 13-16, 18-20 and 26-28 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Pat. No. 6,632,729 to Paton in view of Effects of low-temperature water vapor annealing of strained SiG surface-channel pMOSFETs with high-K dielectric to Westlinder et al. (Westlinder) as cited in IDS filed 08/11/2005.and U.S. Pat. No. 6,909,151 to Hareland et al. (Hareland).

Regarding claim 1, Paton discloses a method of forming a semiconductor device, the method comprising:

providing a substrate including SiGe with a surface portion (Fig 1 Si-Ge containing substrate, col 3 lines 53-54));

depositing a high-k dielectric layer (Fig 1 "high-k gate oxide layer", col 2 lines 9-13) onto the surface portion of the SiGe surface layer; and

forming an oxide layer (Fig 1 "low-K SiO2 layer", col 2 lines 40-44) between the high-k dielectric layer and an unreacted portion of the SiGe surface layer by oxidizing a surface portion of the SiGe surface layer (col 2 lines 36-39), the oxide layer being formed during one or both of said depositing and an annealing process after said depositing (during anneal, col 2 lines 30-44)

forming an electrode layer (Fig 1 "gate") on the high-k dielectric layer.

Paton fails to explicitly disclose the SiGe substrate with a surface portion as a substrate with a SiGe surface layer where the oxidizing of the surface portion of the SiGe surface layer substantially prevents oxidation of the Si substrate during the depositing of the high-k dielectric or annealing process . Westlinder teaches a substrate (see Fig 1) with a SiGe surface layer (10m SiGe) where the oxidizing of the surface portion of the SiGe surface layer substantially prevents oxidation of the Si substrate during the depositing of the high-k dielectric or annealing process (as there is no oxide formed between SiGe layer and substrate). It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Paton to include a SiGe surface layer as taught by Westlinder in order to improve device properties such as channel mobility and stability.

Paton fails to explicitly disclose providing a substrate and forming a SiGe surface layer having an average Ge content less than about 10 at.% on the substrate wherein the SiGe surface layer has an unreacted portion in contact with the substrate. Hareland providing a substrate (302) and forming a SiGe surface layer (308) having an average Ge content less than about 10 at.% (less than 25%, col 9 lines 22-24) on the substrate

wherein the SiGe surface layer has an unreacted portion in contact with the substrate. It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Paton to have the substrate with the SiGe surface layer having an average Ge content less than about 10 at.%. as in Hareland in order to modify device properties such as enhancement of carrier mobility to improve device performance.

Regarding claim 2, Paton in view of Hareland discloses the method according to claim 1 as above. Paton fails to disclose the substrate provided with an initial oxide layer. Hareland also discloses the substrate provided with an initial oxide layer (Figures 5A-5E, element 506, col 9 lines 9-12) prior to forming the SiGe (508/520) surface layer. It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Paton to have an initial oxide as in Hareland in order to provide for improved device isolation.

Regarding claim 3, Paton in view of Hareland discloses the method according to claim 1 as above. Paton also includes forming the SiGe surface layer by performing thermal chemical vapor deposition, plasma-enhanced chemical vapor deposition, atomic layer deposition, or sputtering (chemical vapor deposition, col 2 lines 10-13).

Regarding claim 13, Paton in view of Hareland discloses the method according to claim 1 as above. Paton in view of Hareland fail to explicitly disclose the SiGe surface layer is less than about 1000 angstroms thick. Westlinder also discloses the SiGe surface layer is less than about 1000 angstroms thick (10 nm, see Figure 1, which is 100 angstroms thick). It would have been obvious to one of ordinary skill in the art at the time the invention was made to further modify Paton to have the SiGe surface layer less

than about 1000 angstroms as in Westlinder in order to modify device properties such as enhancement of carrier mobility to improve device performance.

Regarding claim 14, Paton in view of Hareland discloses the method according to claim 1 as above. Paton in view of Hareland fail to explicitly disclose he SiGe surface layer is between about 10 - 300 angstroms thick. Westlinder also discloses the SiGe surface layer is between about 10 - 300 angstroms thick (10 nm, see Figure 1, which is 100 angstroms thick). It would have been obvious to one of ordinary skill in the art at the time the invention was made to further modify Paton to have the SiGe surface layer between about 10 - 300 angstroms thick as in Westlinder in order to modify device properties such as enhancement of carrier mobility to improve device performance.

Regarding claim 15, Paton in view of Hareland discloses the method according to claim 1 as above. Paton also discloses the high-k dielectric layer comprises at least one of HfO_2, $HfSiO_x$, ZrO_2, $ZrSiO_x$, TiO_2, Ta_2O_5, Al_2O_3, or SiN (col 1 lines 65- col 2 lne 9).

Regarding claim 16, Paton in view of Hareland discloses the method according to claim 1 as above. Paton also discloses the high-k dielectric layer is between about 5 – 60 angstroms thick (40-100 Å, which includes range of 40-60 Å col 2 line 59).

Regarding claim 18, Paton in view of Hareland discloses the method according to claim 1 as above. Paton fails to disclose etching the elecltoryde and high-k dielectric layer. Hareland also discloses etching the electrode layer and the high-k dielectric layer (col 11, lines 42-46). It would have been obvious to one of ordinary skill in the art at the

time the invention was made to modify Paton to etch the electrode layer and high-k dielectric layer in order to form devices on the substrate.

Regarding claim 19, Paton in view of Hareland discloses the method according to claim 1 as above including the oxide formed during an annealing process. Paton fails to explicitly disclose the oxide layer formed by exposing the substrate to an oxygen containing gas. Westlinder discloses an oxide layer formed by exposing the substrate to an oxygen containing gas (exposed to water vapor anneal, page 526 col 1 paragraph 3, and oxygen is present in H_2O). It would have been obvious to one of ordinary skill in the art at the time the invention was made to further modify Paton to expose to oxygen gas as in Westlinder in order to control the formation of the oxide to a desired level.

Regarding claim 20, Paton discloses a method of forming a semiconductor device, the method comprising:

providing a substrate including SiGe with a surface poriton (Fig 1 Si-Ge containing substrate, col 3 lines 53-54));

depositing a high-k dielectric layer (Fig 1 "high-k gate oxide layer", col 2 lines 9-13) onto the surface portion of the SiGe surface layer;

annealing the substrate having the SiGe and high-k dielectric thereon (anneal, col 2 lines 30-44); and

forming an electrode layer (Fig 1 "gate") on the high-K dielectric layer.

wherein at least one of the depositing and annealing comprising to form an oxide layer (Fig 1 "low-K SiO2 layer", col 2 lines 40-44) between the dielectric layer and an unreacted portion of the SiGe surface layer .

Paton fails to explicitly disclose the oxide layer formed by exposing the substrate to an oxygen containing gas. Westlinder discloses an oxide layer formed by exposing the substrate to an oxygen containing gas (exposed to water vapor anneal, page 526 col 1 paragraph 3, and oxygen is present in H_2O). It would have been obvious to one of ordinary skill in the art at the time the invention was made to further modify Paton to expose to oxygen gas as in Westlinder in order to control the formation of the oxide to a desired level.

Paton fails to explicitly disclose the SiGe substrate with a surface portion as a substrate with a SiGe surface layer where the oxidizing of the surface portion of the SiGe surface layer substantially prevents oxidation of the Si substrate during the depositing of the high-k dielectric or annealing process . Westlinder teaches a substrate (see Fig 1) with a SiGe surface layer (10m SiGe) where the oxidizing of the surface portion of the SiGe surface layer substantially prevents oxidation of the Si substrate during the depositing of the high-k dielectric or annealing process (as there is no oxide formed between SiGe layer and substrate). It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Paton to include a SiGe surface layer as taught by Westlinder in order to improve device properties such as channel mobility and stability.

Paton fails to explicitly disclose providing a substrate and forming a SiGe surface layer having an average Ge content less than about 10 at.% on the substrate wherein the SiGe surface layer has an unreacted portion in contact with the substrate. Hareland providing a substrate (302) and forming a SiGe surface layer (308) having an average

Ge content less than about 10 at.% (less than 25%, col 9 lines 22-24) on the substrate wherein the SiGe surface layer has an unreacted portion in contact with the substrate. It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Paton to have the substrate with the SiGe surface layer having an average Ge content less than about 10 at.%. as in Hareland in order to modify device properties such as enhancement of carrier mobility to improve device performance.

Regarding claim 26-28, Paton discloses a method of forming a semiconductor device, the method comprising:

providing a single crystal silicon or polycrystalline silicon substrate including an Si-Ge surface (Fig 1 Si-Ge containing substrate, col 3 lines 53-54));

depositing an oxygen-containing high-k dielectric layer (Fig 1 "high-k gate oxide layer", col 2 lines 9-13) onto the surface portion of the SiGe surface layer;

forming an oxide layer (Fig 1 "low-K SiO2 layer", col 2 lines 40-44) between the oxygen-containing high-k dielectric layer and an unreacted portion of the SiGe surface layer (col 2 lines 36-39), the oxide layer being formed during one or both of said depositing and an annealing process after said depositing (during anneal, col 2 lines 30-44); and

forming an electrode layer (Fig 1 "gate") on the high-K dielectric layer.

Paton fails to explicitly disclose the oxide layer formed by exposing the substrate to an oxygen containing gas under oxidizing conditions and diffusing oxygen. Westlinder discloses an oxide layer formed by exposing the substrate to an oxygen containing gas (exposed to water vapor anneal, page 526 col 1 paragraph 3, and oxygen is present in

H_2O and would be diffused). It would have been obvious to one of ordinary skill in the art at the time the invention was made to further modify Paton to expose to oxygen gas as in Westlinder in order to control the formation of the oxide to a desired level.

Paton fails to explicitly disclose the SiGe substrate with a surface portion as a substrate with a SiGe surface layer where the oxidizing of the surface portion of the SiGe surface layer substantially prevents oxidation of the Si substrate during the depositing of the high-k dielectric or annealing process . Westlinder teaches a substrate (see Fig 1) with a SiGe surface layer (10m SiGe) where the oxidizing of the surface portion of the SiGe surface layer substantially prevents oxidation of the Si substrate during the depositing of the high-k dielectric or annealing process (as there is no oxide formed between SiGe layer and substrate). It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Paton to include a SiGe surface layer as taught by Westlinder in order to improve device properties such as channel mobility and stability.

Paton fails to explicitly disclose providing a substrate and forming a SiGe surface layer having an average Ge content less than about 10 at.% on the substrate wherein the SiGe surface layer has an unreacted portion in contact with the substrate. Hareland providing a substrate (302) and forming a SiGe surface layer (308) having an average Ge content less than about 10 at.% (less than 25%, col 9 lines 22-24) on the substrate wherein the SiGe surface layer has an unreacted portion in contact with the substrate. It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Paton to have the substrate with the SiGe surface layer having an

average Ge content less than about 10 at.%. as in Hareland in order to modify device properties such as enhancement of carrier mobility to improve device performance.

Claims 4-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Pat. No. 6,632,729 to Paton in view of Effects of low-temperature water vapor annealing of strained SiG surface-channel pMOSFETs with high-K dielectric to Westlinder et al. (Westlinder) as cited in IDS filed 08/11/2005 and U.S. Pat. No. 6,909,151 to Hareland et al. (Hareland) and in view of EP 0684 650 B1 to Hiroshi et al. (Hiroshi) as cited in IDS filed 03/10/2004.

Regarding claims 4-5, Paton in view of Hareland discloses the method according to claim 1 as above. Paton in view of Hareland fails to disclose forming the SiGe surface layer by exposing the substrate to a process gas including a Ge-containing gas comprising at least one of GeH_4 or $GeCl_4$. Hiroshi includes forming the SiGe surface layer by exposing the substrate to a process gas including a Ge-containing gas comprising at least one of GeH_4 or $GeCl_4$ (GeH_4, paragraph [0046]). It would have been obvious to one of ordinary skill in the art at the time the invention was made to further modify Paton to have the form the SiGe surface layer as in Hiroshi to provide a high quality SiGe layer.

Regarding claim 6, Paton as modified discloses the method according to claim 4 as above. Paton discloses annealing the substrate either during said exposing, after said exposing, or both during and after said exposing (col 2 lines 30-44).

Regarding claims 7-8, Paton in view of Hareland discloses the method according to claim 4 as above. Paton in view of Hareland fails to disclose the process gas comprising a Si-containing gas comprising at least one of SiH_4, Si_2H_6, or SiH_2Cl_2. Hiroshi includes the Si-containing gas comprising at least one of SiH_4, Si_2H_6, or SiH_2Cl_2 (Si_2H_6, paragraph [0046]). It would have been obvious to one of ordinary skill in the art at the time the invention was made to further modify Paton to have the form the SiGe surface layer as in Hiroshi to provide a high quality SiGe layer.

Claims 10 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Pat. No. 6,632,729 to Paton in view of Effects of low-temperature water vapor annealing of strained SiG surface-channel pMOSFETs with high-K dielectric to Westlinder et al. (Westlinder) as cited in IDS filed 08/11/2005 and U.S. Pat. No. 6,909,151 to Hareland et al. (Hareland) and U.S. Pub. No. 2003/0218189 to Christiansen et al. (Christiansen).

Regarding claims 10 and 11, Paton in view of Hareland discloses the method according to claim 1 above. Paton fails to disclose the SiGe surface layer comprising a plurality of SiGe sublayers each with different Ge content and also fails to disclose the SiGe surface layer comprising a graded Ge content.

Christiansen discloses a plurality of SiGe sublayers (Figure 8 layers 45, 42, 25, and 35) each with different Ge content (paragraph 82, last 3 lines) and the SiGe surface layer with a graded Ge content (Figure 9 layers 46, 37, 37 and 43, paragraph 38). It would have been obvious to one of ordinary skill in the art at the time the invention was

made to further modify Paton to have the SiGe surface layer comprising a plurality of SiGe sublayers each with different Ge content and the SiGe surface layer comprising a graded Ge content as in Christiansen in order to reduce defects normally present in a single SiGe layer (Christiansen, paragraph 15).

Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Pat. No. 6,632,729 to Paton in view of Effects of low-temperature water vapor annealing of strained SiG surface-channel pMOSFETs with high-K dielectric to Westlinder et al. (Westlinder) as cited in IDS filed 08/11/2005 and U.S. Pat. No. 6,909,151 to Hareland et al. (Hareland) and U.S. Pat. No. 5,259,881 to Edwards et al. (Edwards).

Regarding claim 17, Paton in view of Hareland discloses the method according to claim 1 as above with an Si substrate. Paton in view of Hareland fails to disclose introducing the substrate into a process chamber of one of a single wafer processing system and a process chamber of a batch-type processing system. Edwards teaches introducing a substrate into a process chamber of a batch-type processing system (col 3 lines 6-13). It would have been obvious to one of ordinary skill in the art at the time the invention was made to further modify Paton to include introducing the Si substrate into a process chamber of a batch-type processing system in order to maximize the add to the speed and flexibility of the substrate processing (Edwards, lines 14-17).

Response to Arguments

Applicant's arguments with respect to claims 1-8, 10-11, 13-21 ad 26-28 have been considered but are moot in view of the new ground(s) of rejection.

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Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Colleen A. Matthews whose telephone number is (571)272-1667. The examiner can normally be reached on Monday - Friday 8AM-4:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Lynne Gurley can be reached on 571-272-1670. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/C. A. M./
Examiner, Art Unit 2811

/Lynne A. Gurley/
Supervisory Patent Examiner, Art Unit 2811